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**Optimal census by quorum sensing**

THIBAUD TAILLEFUMIER, Princeton University

Bacteria regulate their gene expression in response to changes in local cell density in a process called quorum sensing. To synchronize their gene-expression programs, these bacteria need to glean as much information as possible about local density. Our study is the first to physically model the flow of information in a quorum-sensing microbial community, wherein the internal regulator of the individuals response tracks the external cell density via an endogenously generated shared signal. Combining information theory and Lagrangian optimization, we find that quorum-sensing systems can improve their information capabilities by tuning circuit feedbacks. At the population level, external feedback adjusts the dynamic range of the shared input to individuals detection channels. At the individual level, internal feedback adjusts the regulators response time to dynamically balance output noise reduction and signal tracking ability. Our analysis suggests that achieving information benefit via feedback requires dedicated systems to control gene expression noise, such as sRNA-based regulation.